



Including Health Cost in the CEEH version of the Energy System Optimisation Model Balmorel

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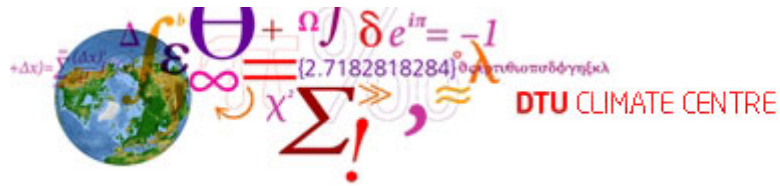
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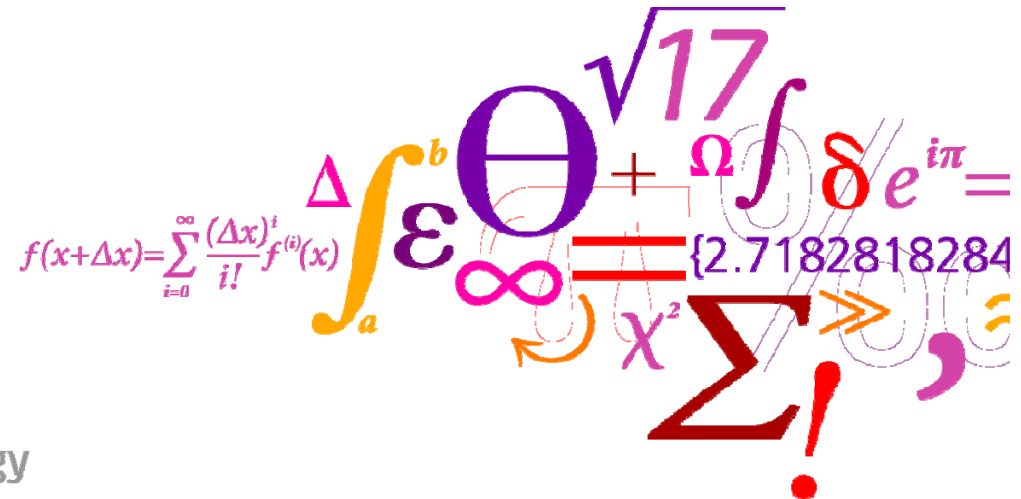
Olexandr Balyk and Kenneth B. Karlsson

DTU Climate Centre, Risø DTU

International Conference on Energy, Environment and Health – Optimisation of Future Energy Systems

May 31st, 2010

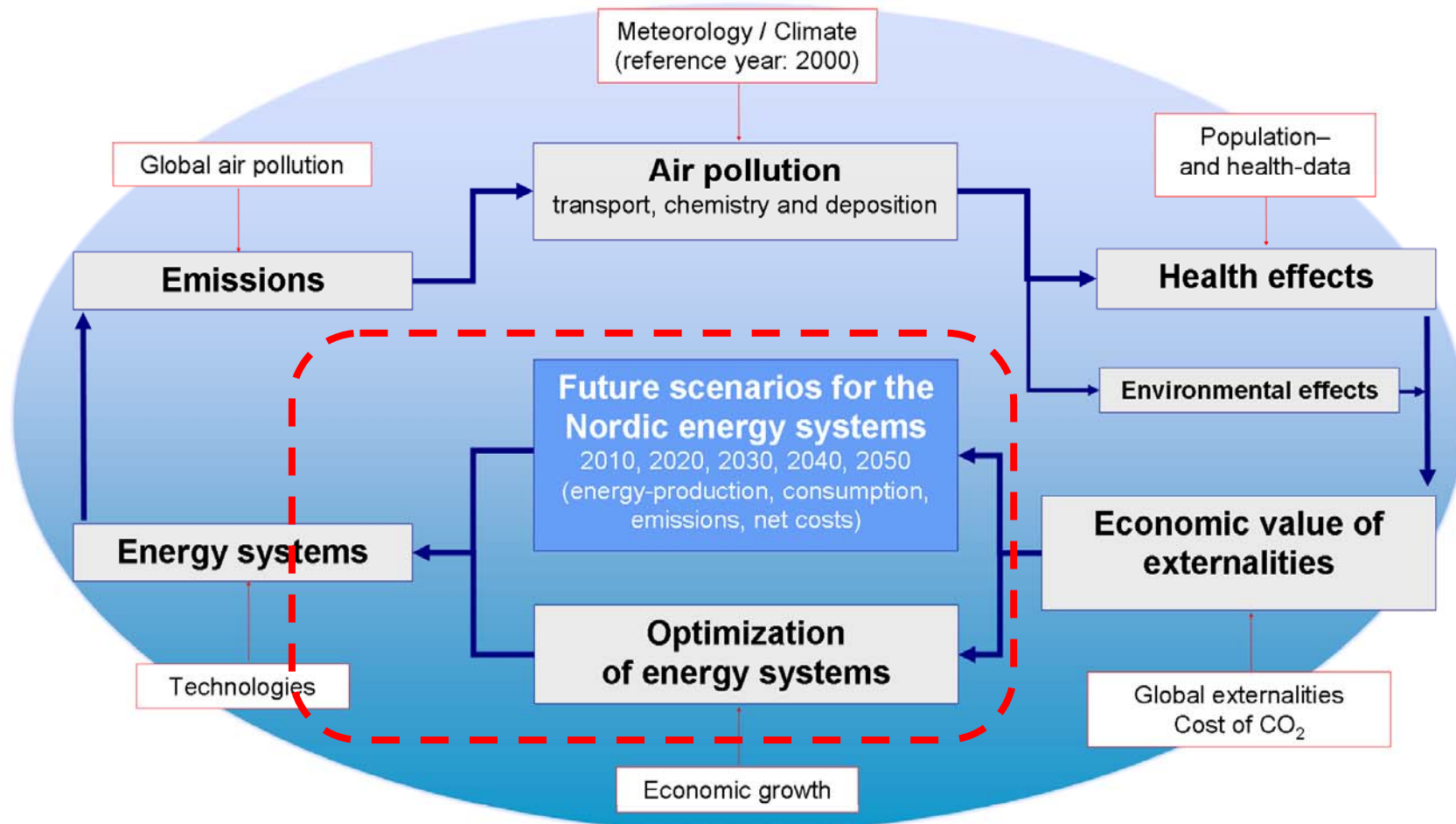
Copenhagen, Denmark



Risø DTU

National Laboratory for Sustainable Energy

CEEH Modelling Framework



Balmorel in Brief

Model:

Multi region linear optimisation model,
Interregional power market,
Regional district heat markets

Exogenous input:

Energy prices,
Electricity demand in regions,
Heat demand in heat areas

Results:

Prices on traded energy,
Investments in power plants,
Investments in transmission lines,
Emissions from each region



Balmorel: Additional Features

Health Costs

Mechanism to take into account damage arising from emission of SO₂, CO, PM_{2.5}, and NO_x.

Possible to take into account factors like population density, meteorology by varying cost depending on an area.

Heat Savings (E. Zvingilaite)

Possibility to invest in heat saving measures and thereby reduce heat demand. Dependent upon renovation rate, building type, potential.

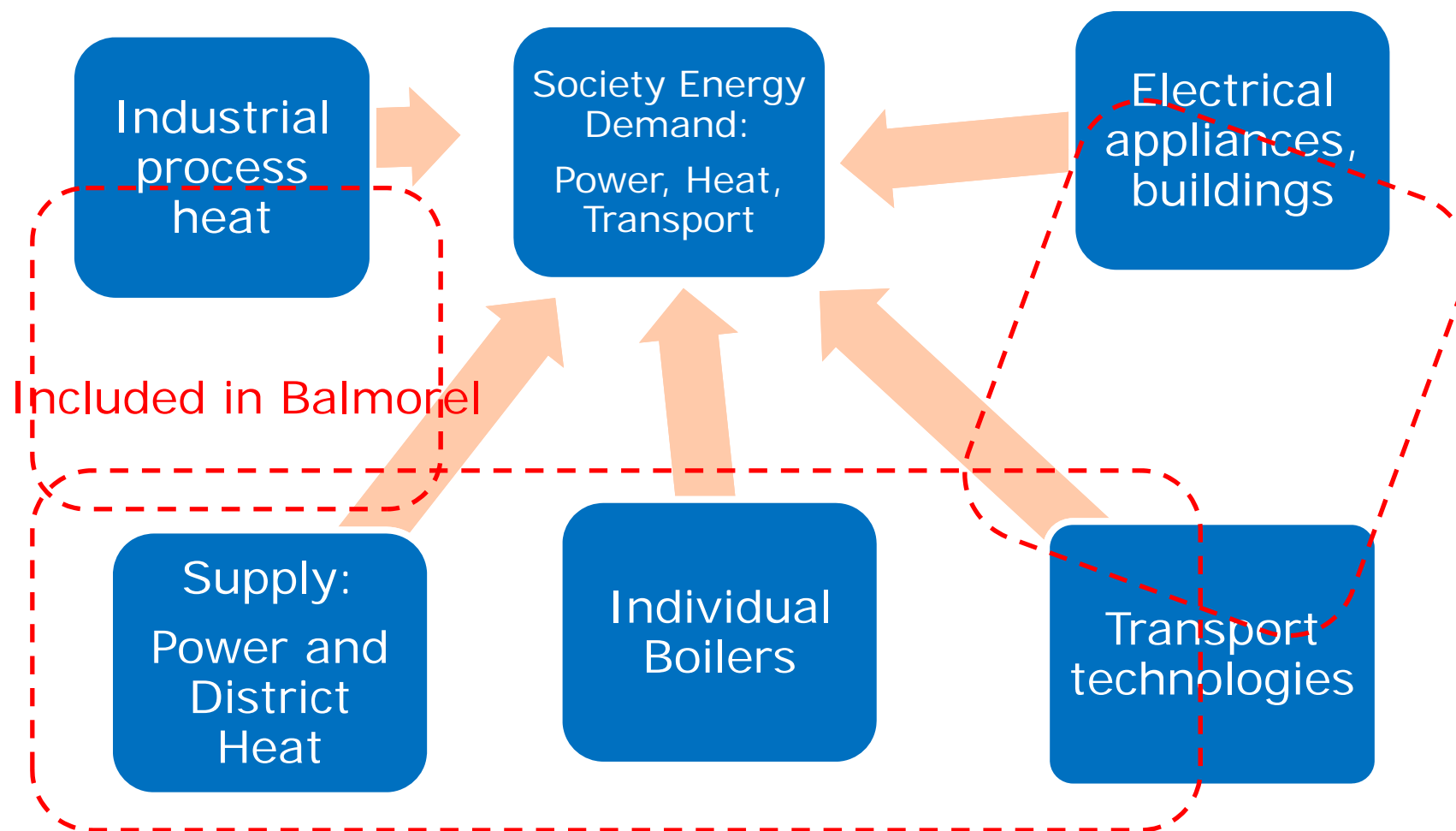
Individual Heating (E. Zvingilaite)

Handling individual heating investment options, related emissions etc.

Hydrogen (K. Karlsson and P. Meibom)

Utilisation of hydrogen-based technologies for transport and electricity storage.

Energy System

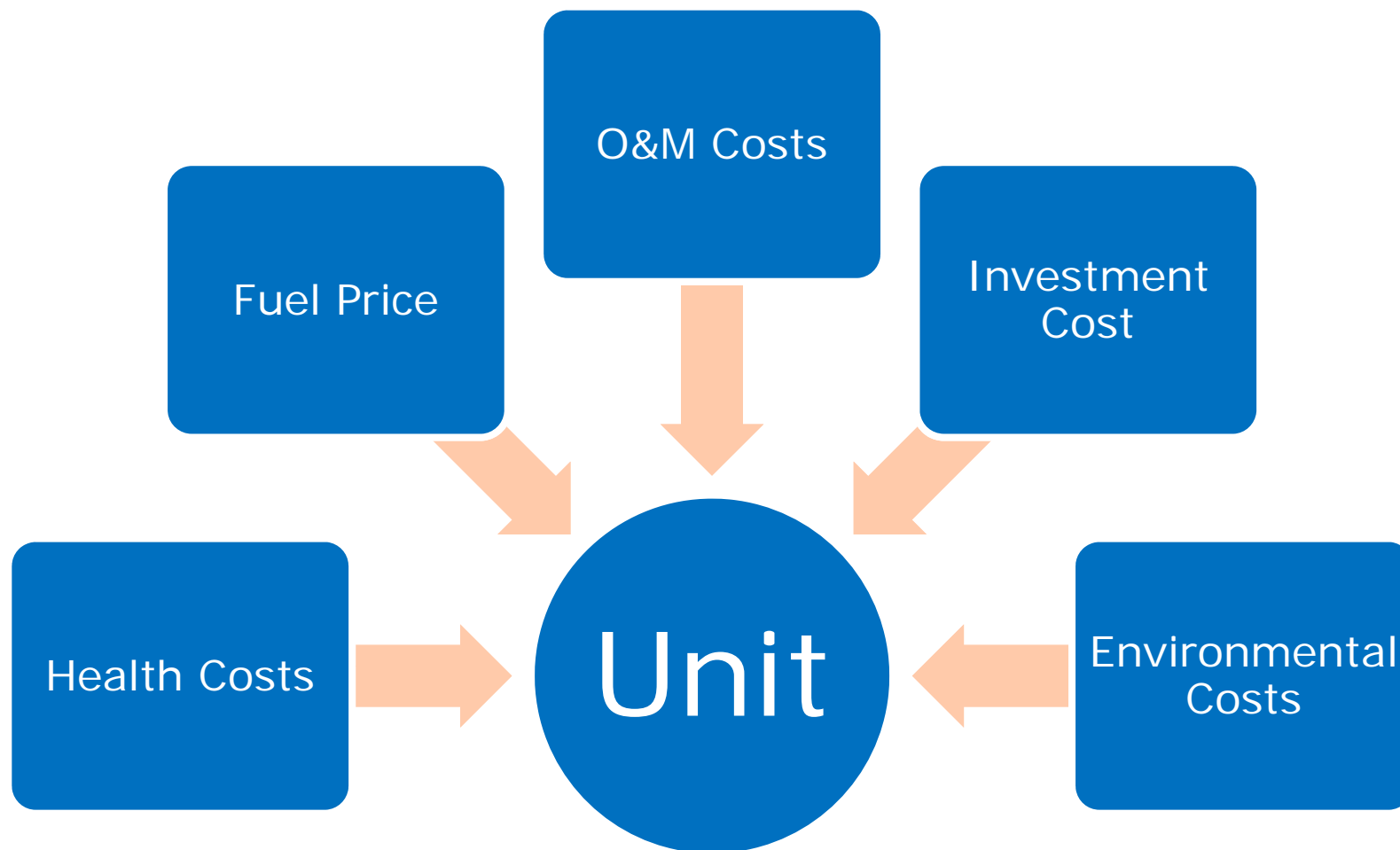


Health Costs

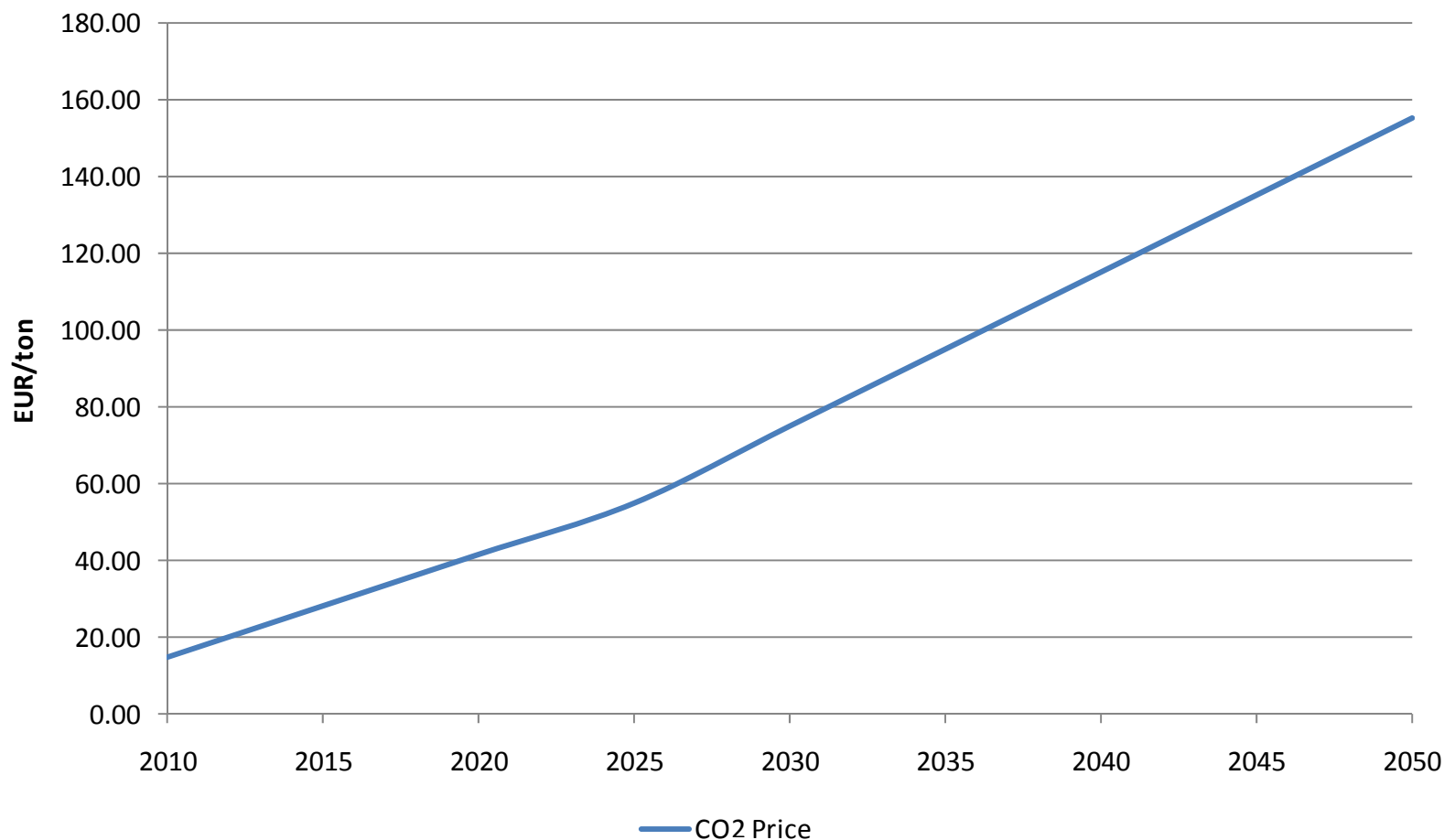
Sector	Emission year	CO [C]	S [S]	N [N]	PM25
Combustion in energy and transformation	2000	0,001	22,2	23,9	19,2
Non-industrial combustion plants	2000	0,002	32,7	33,8	28,4
Combustion in manufacturing industry	2000	0,001	27,0	27,6	19,8
Production processes	2000	0,014	44,9	110,5	41,2
Road transport	2000	0,003	188,5	33,3	44,4
International ship traffic	2000	0,000	26,7	26,3	22,1

Cost in EUR/kg

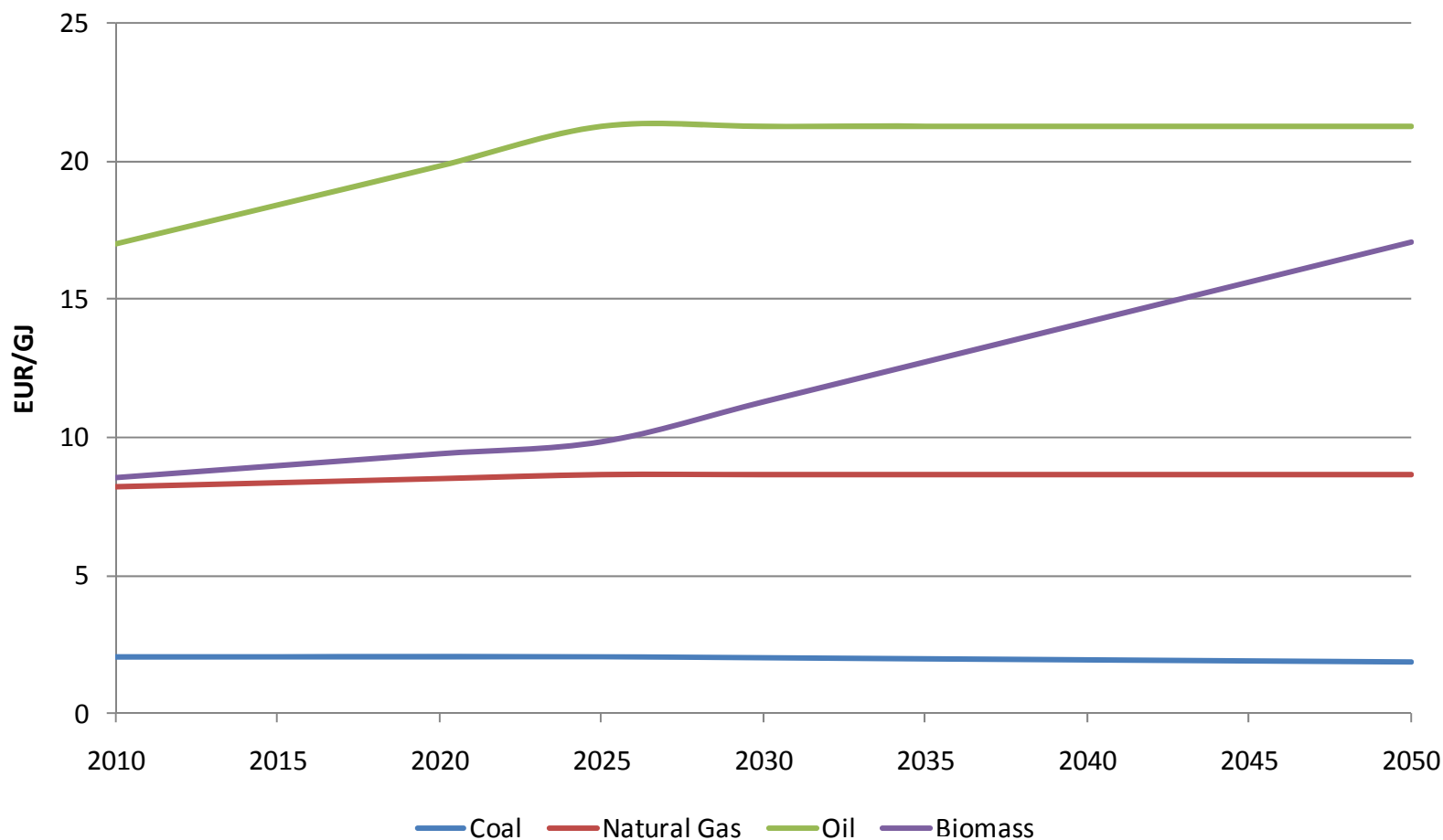
Energy System Modelling: Cost of Running a Unit in an Energy System



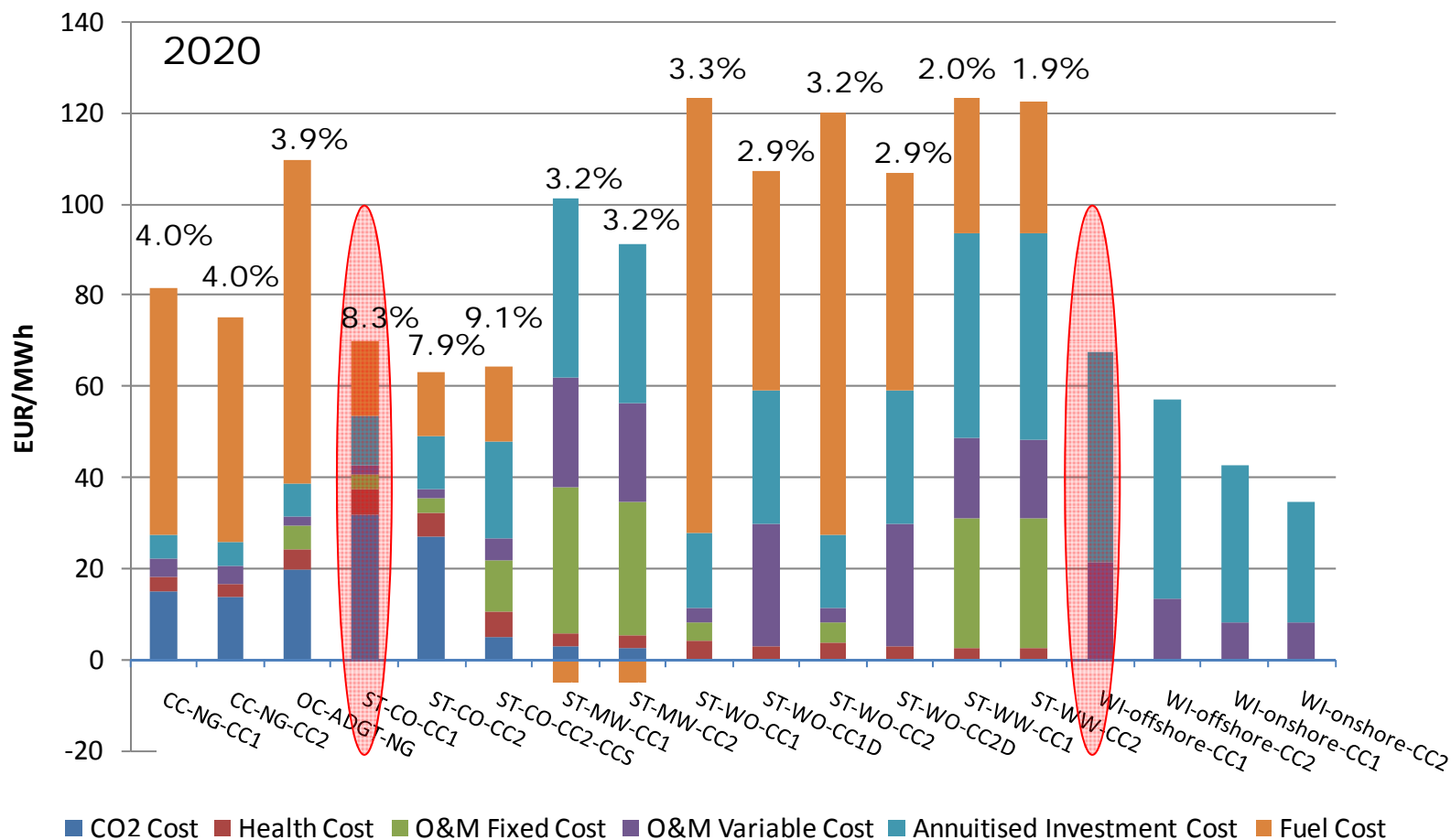
Assumptions I: CO2 Price Development



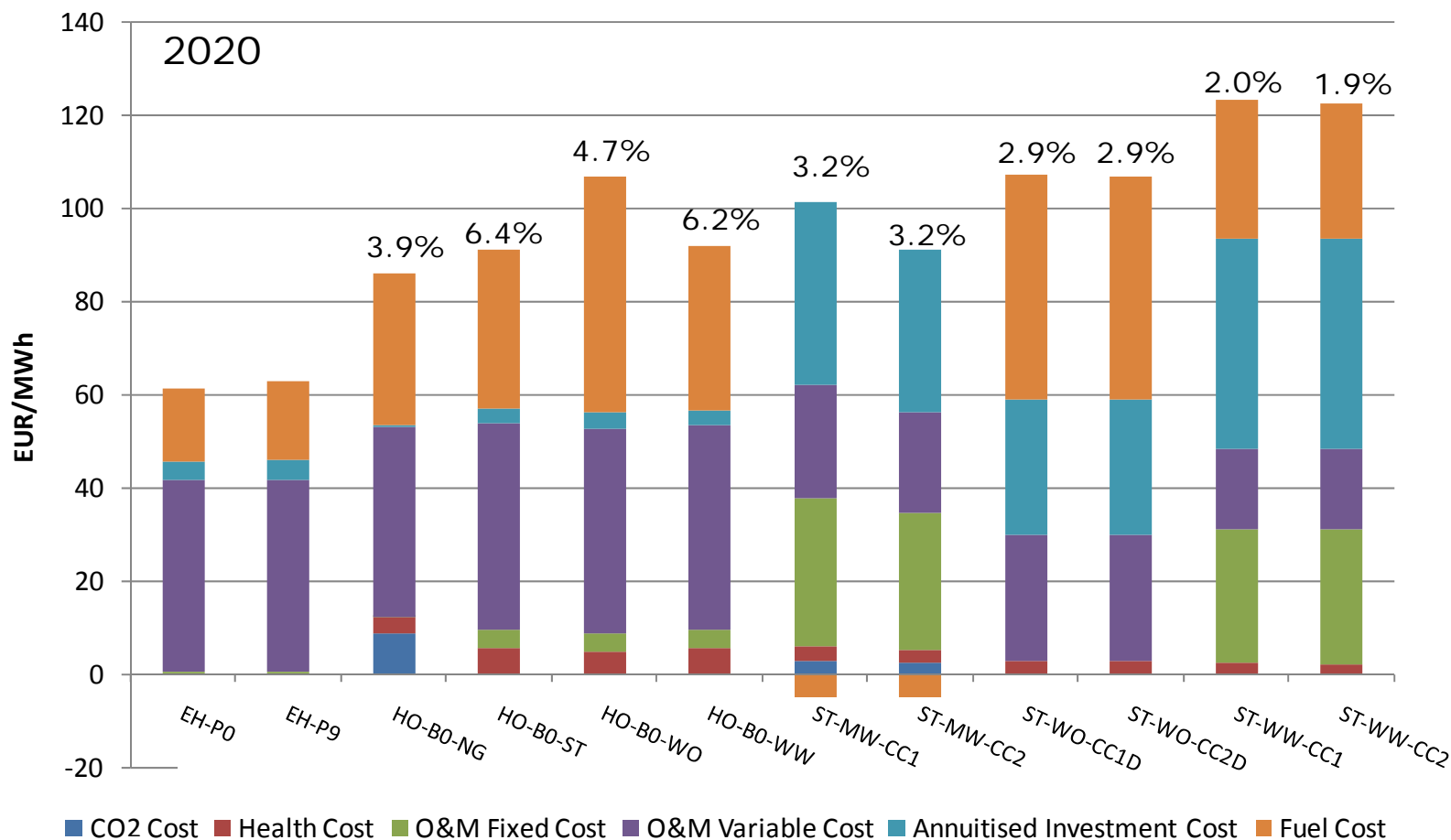
Assumptions II: Fuel Price Development



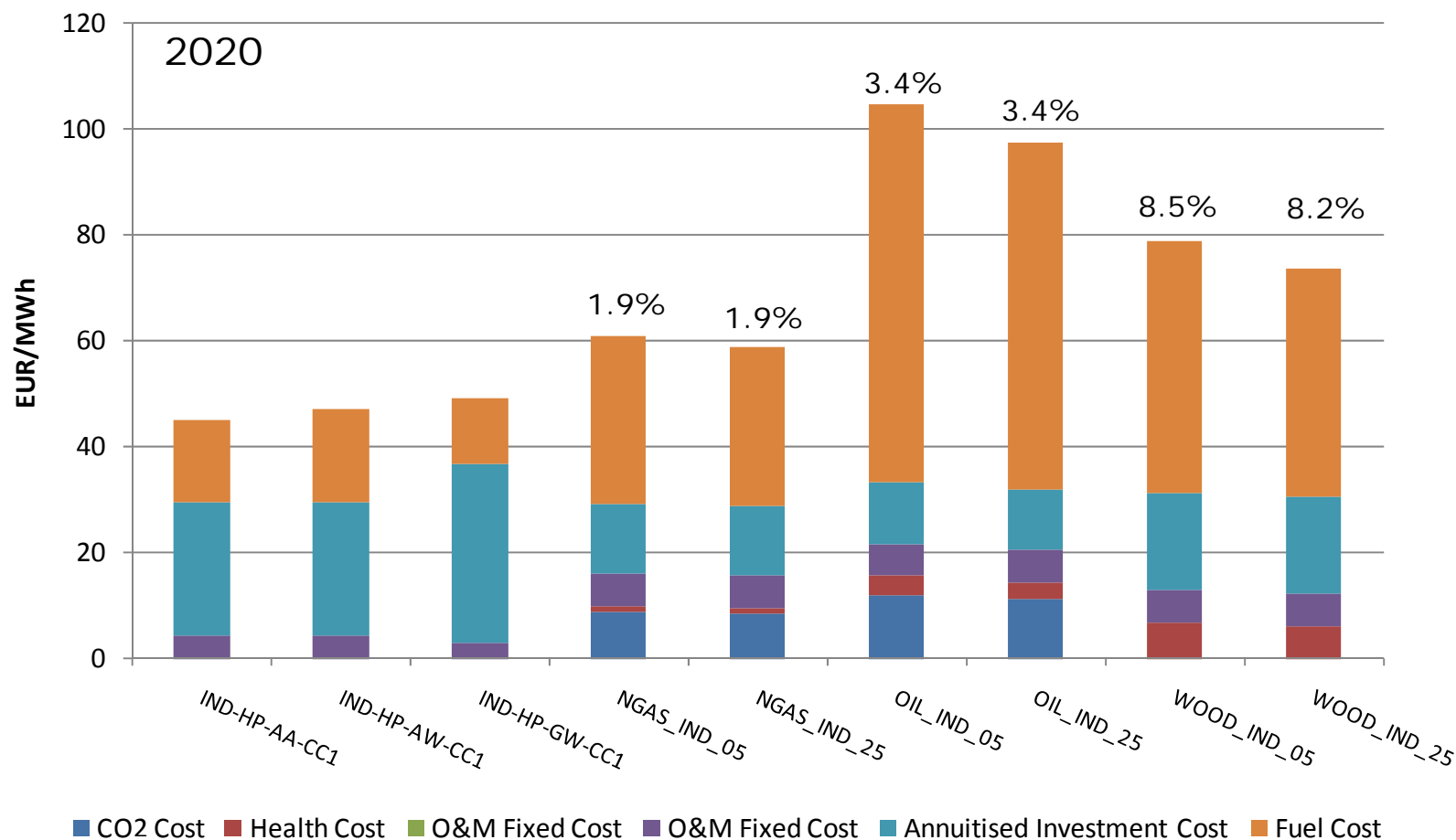
Technology Competitiveness I: Electricity



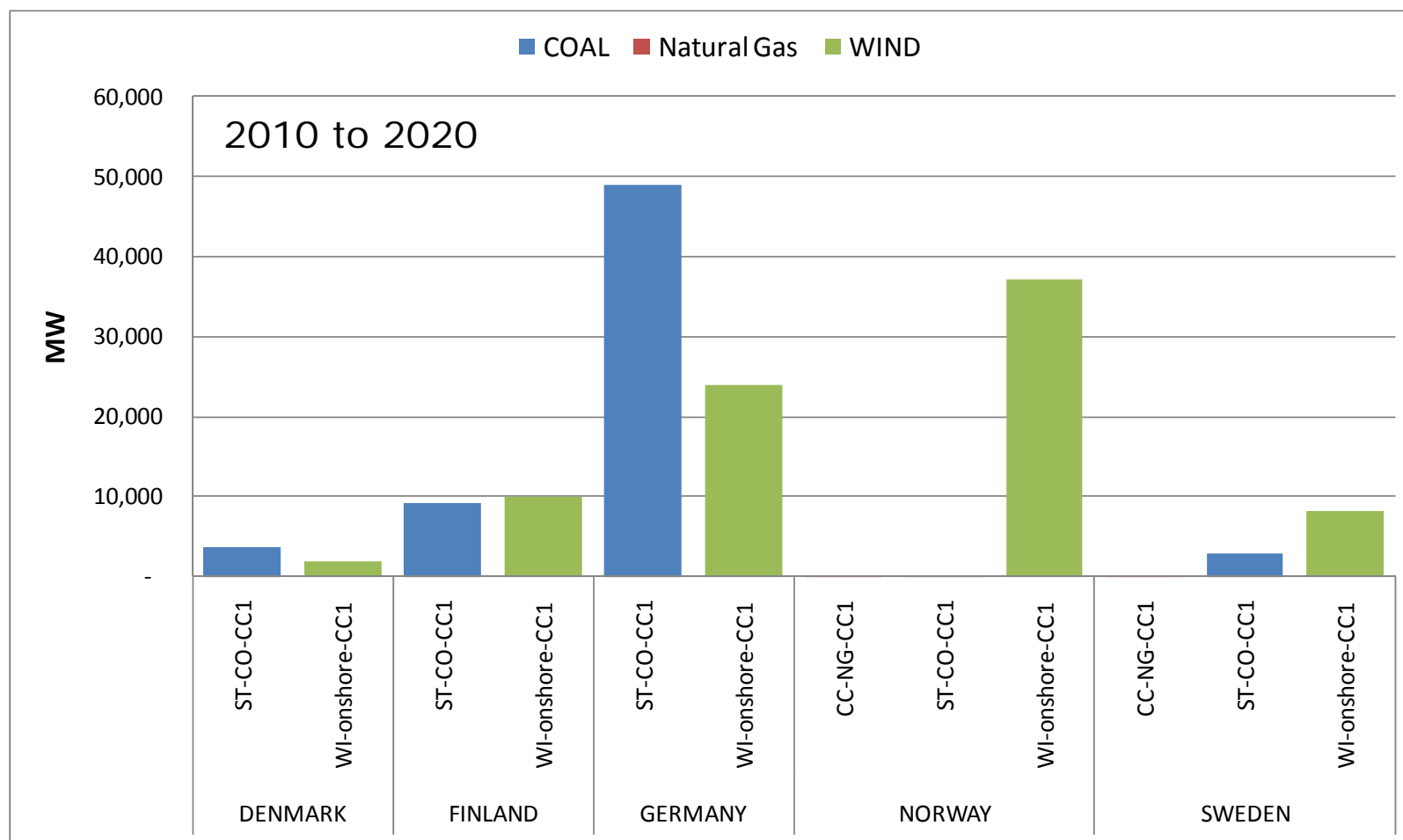
Technology Competitiveness II: District Heating

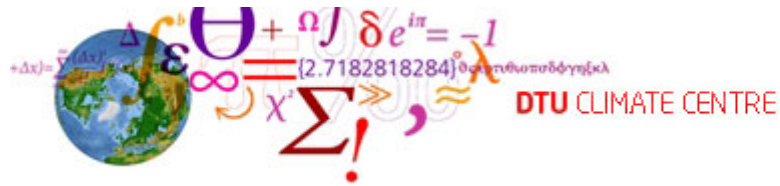


Technology Competitiveness III: Individual Heating



Example of Results: New Power Capacity





Way Forward

Inclusion of transportation

Possibility of investing in car fleet

Competition between different technologies, e.g. electric, gasoline.

Inclusion of industrial processes

Possibility of fuel substitution

Electricity Savings

Possibility of investing in more efficient appliances

THANK YOU FOR YOUR ATTENTION!

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DTU Climate Centre:

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